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ABSTRACT

Wastewater treatment, microbiology, biochemistry, and engineering are the major subject areas covered in this preliminary thesaurus designed for use in a private information retrieval system. The thesaurus was developed through meetings where each descriptor was discussed, necessary scope notes were written, definition and cross references were added, and the final term format was compared with other thesauri. Included are directions for retrieval procedures, guidelines for indexing, an explanation of the main entry format of the descriptors, and the 220 descriptors. (JAB)

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A Preliminary Thesaurus

of

Environmental Engineering Terms

for an

Individual Information Retrieval System

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IR 006 111

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Joni K. Grady
March 21, 1978
G.S.L.S. 381
Special Project
Submitted to
Prof. E. B. Jackson
UT Austin

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A Preliminary Thesaurus--Development

Background

There was, at a great midwestern university, a professor of environmental engineering who had been collecting reprints of articles for fifteen years. These covered a broad range of topics, reflecting the interdisciplinary aspect of the field and the areas of his research interests and teaching responsibilities, from microbiology, biochemistry and mathematics to nuts-and -bolts engineering. He had also set up an information retrieval system for the collection and had conscientiously kept it up-to-date during his years in graduate school. However, the periods of up-dating had become few and far between in recent years.

In 1976, before this work was begun, the system consisted of 1200 or so numbered reprint articles in boxes. About half of these had had descriptor terms assigned and the article number entered on the appropriate descriptor number card (see sample card 1.). Two author cards had been made for each article, one to be filed by the author's name (sample card 2.), the other to be filed in numerical order (sample card 3.). Those articles that had been indexed had the descriptors indicated on the second author card (sample card 3.). The only "thesaurus" was composed of one card for each letter of the alphabet with the appropriate terms, chosen by the professor, listed in random order (sample card 4.).

This arrangement, combined with the professor's excellent memory, had worked fairly well while both the number of articles and research topics remained small. However, as the professor's interests, and those of his students, multiplied and diversified, so did the pile of articles. Even had all the articles been indexed, retrieval would have been difficult with his personal attention and impossible without it. Because the system was a personal one, the professor had felt quite free in the initial choices of descriptors. The lack of order in the process had led to various problems, however. There were several cases of synonymous terms being chosen at different times with their subsequent use being a matter of chance.

Sample card 1. Number descriptor card.

Industrial Wastes

0	1	2	3	4	5	6	7	8	9
740	1	742	753	744	695	746	727	728	659
	611	832	853	754	785	826	747	758	1019
	741	1162	1203	784	1125	1006	837	1288	1199
	821		1213	1019	1245	1206	857		1309
	281		1273	1134	1265		1187		1359
	1061		1313	1194	1295		1207		
				1204	1375		1237		
				1304	1375		1277		
				1374					

Sample card 2. Author file card.

1162 1162

Franzen, A.E., Skogan, V.G. & Grutsch, J.F.

"Tertiary Treatment Of Process Water"

Chemical Engineering, 68, 8, 65-72, August 1972

Sample card 3. Author number card.

1162 1162

Franzen,A.E., Skogan,V.G. & Grutsch, J.F.

"Tertiary Treatment of Process Water"

Chemical Engineering, 68, 8, 65-72, August 1972

Flotation
Coagulation
Unit ops
Industrial wastes
Petrochemicals

Samplecard 4. "Thesaurus" card

O

- Oxygen tension
- oxygen requirement
- oxygen transfer
- ORP
- Organic contaminants (determination of low levels)
- Optimization
- Odor
- Operation and Maintenance
- oxygen measurement
- Oxygenation

Some broad terms were subdivided unnecessarily and one or more of the narrower terms never used; others that should have been subdivided were not. Most important was the fact that there were no internal aids, no cross-references available. If the searcher didn't happen to pick the right term at first, he had either to continue guessing at various possibilities, scan the entire list of terms or wait for help.

Another problem had developed from the lack of definitions and scope notes accompanying the more esoteric terms used. Not only were searchers (including the professor) frequently unsure of the implications and use of these terms, but it was impossible for anyone but the professor to do the indexing. A thesaurus of terms which would allow both indexing and searching by people other than the professor seemed the obvious answer.

Developing the thesaurus

As a first step in sorting out the system, each term was put on a separate card and, after discussion with the professor, scope notes, definitions and possible cross references were added. During this activity many inconsistencies were discovered, some terms rarely used were dropped, others combined, and in some cases alternate ones suggested for possible substitution.

Next the cards were compared to other thesauri.[1-4] As a word was found, the suggested cross references were checked for applicability and the appropriate entries made. Subject area dictionaries were also consulted to clarify definitions made earlier. After checking and rechecking, the thesaurus was prepared for duplication. During this latter period, the most recent 400 or so unindexed papers were put into the system as a check on the usefulness of the new thesaurus.

Problems and possibilities

The basic problem lay in trying to develop a system that will allow indexing of each paper at the appropriate depth for use in a very particular special library. The published thesauri were too general in some areas and too narrow in others to

be used without modification, but they were very useful in developing the "Related terms" lists. On the other hand, the lack of thesauri in the fields of biochemistry and microbiology means that those terms are not as well cross-referenced as the engineering terms. It is hoped that further indexing will suggest more "Related terms" entries in those areas, just as it will allow modifications and improvements in general in this very preliminary thesaurus.

Someday the thesaurus should be expanded to cover all areas of environmental engineering being taught at this great university, and each professor's reprints should be made retrievable. It is also possible that a subject category index and a hierarchical index would both be useful additions. Ultimately, of course, one would desire a computerized system.

Reference Thesauri

1. BioSciences Information Service of Biological Abstracts. Search Guide, Biosis Previews edition. Phil., PA:Biological Abstracts, 1977.

2. Engineers Joint Council. Thesaurus of Engineering and Scientific Terms. New York: Engineers Joint Council, 1967.

3. U.S. Dept. of Commerce. Environmental Microthesaurus. Wash. D.C.: G.P.O., 1977.

4. U.S. Dept. of the Interior. Thesaurus of Water Resources Terms. Wash. D.C.: G.P.O., 1971.

PRELIMINARY THESAURUS

for use with

the C.P.L.G Reprint Files

USING THE THESAURUS

This thesaurus has been developed over a two year period at great expense of time and none of money to aid in the indexing and retrieval of reprints collected by C.P.L.G.

Retrieval

Unless a general retrieval of all articles on a subject is required, it is suggested that the user begin his search with a Boolean algebraic description of his needs in mind, using terms from the thesaurus. He can then pull the descriptor number card for each term and note those reprint numbers appearing on either card for those terms "ORed" and all cards whose terms were "ANDed". Because the system is not computerized, the simpler the search the better.

Examples: 1) Escherichia coli and Continuous culture--steady state and Laboratory methods

2) Design or Economics or Cost and Computers

Refinements may be necessary if too many or two few articles are obtained. It is also generally true that the most recent articles have the highest accession numbers. Once an article number is acquired it is a simple matter to check the number file for a copy of the main entry or author card which lists author, title, bibliographic information, and all descriptors used in indexing the article. Those articles that still seem to fit the requirements may be retrieved from the numbered boxes.

Indexing

It is often possible to use the title, abstract and keywords supplied by some authors as aids in selecting descriptors for an article. In addition to the basic specific terms chosen this way, there are several additional broad terms that are often used:

1) Continuous culture-- or Batch growth, death if the article deals with pure cultures of micro-organisms (as well as the names of the organisms).

2) Laboratory methods if a detailed description of a new or uncommon procedure is given in the body of the paper.

3) Unit operations is always listed if any of the operations is used as a descriptor.

4) Computers if their use is discussed in conjunction with another subject.

5) Review article if extensive references are given, even in research paper.

Most papers can be described in from five to eight terms although some may require more, some fewer.

Examples of entries and notations in thesaurus*

Descriptor entry

A. Descriptor ——— Fixed film reactors
(any scale, full or lab) ——— E. Scope note a.
Def: reactor in which micro-organisms grow in a thin film attached to a medium, not in a slurry. — F. Definition
(Includes reference and review articles) — G. Scope note b.
B. Used For ——— UF Trickling filters ——— H. Use Reference (see below.)
BT-Biochemical operations — I. Broader term
C. Indicates that narrower terms exist under this descriptor — NT Rotating biological contactors — J. Narrower term
RT-Filtration
Flow through porous media } K. Related terms
Fluidization

Use Reference entry

D. Use Reference ——— Trickling filters
U Fixed film reactors ——— L. Descriptor to be used for Trickling filters

Explanation*

A. This is the main entry of the descriptor

B. The descriptor at the main entry is to be used for any term listed under this notation. See L. where reciprocal entry is shown.

C. The dash (-) symbol in front of a descriptor indicates that the descriptor has narrower terms (not shown) or that it is subdivided and that the main entry should be consulted for these.

D. The Use Reference refers the user to the preferred descriptor.

E. Scope note a.(parenthetical expression, uncapitalized). Used when clarification of of meaning is needed.

F. Definition is given only when more formal explanation of term is required.

G. Scope note b. (Parenthetical expression, capitalized). Used when clarification of the use of a term in the system is needed.

H. These terms are Use References, not descriptors (see D.).

I. Broader terms represent a generically broader class which includes the main entry descriptor as a narrower term.

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* Borrowed freely from the U.S. Department of the Interior, Thesaurus of Water Resources Terms. (Washington, D.C.: U.S.G.P.O., 1971) pp.4-5.

J. Narrower terms are the reciprocal of I. above.

K. Related terms have a close association or relationship to main entry descriptor.

L. The descriptor to be used for this Use Reference term.

PRELIMINARY THESAURUS

Acidogenesis
RT Anaerobic growth
Anaerobic processes
Fatty acids
Hydrogen metabolism

Activated carbon (and biological regeneration of)
BT-Unit operations
RT Adsorption--chemical
Odor

Activated sludge--full scale
BT-Biochemical operations
NT Contact stabilization A.S.
Extended aeration A.S.
Pure oxygen A.S.
Step Aeration A.S.
RT Activated sludge--lab scale
Activated sludge--operation & control
Aeration
Bulking
Flocculant cultures, effects
Flocculation--bacterial
Microbial activity & viability--indicators
Settling & sedimentation
Sludge disposal
Sludge volume index

Activated sludge--lab scale
Def: reactor with flocculant slurry and recycle; can be batch or continuous culture.
RT Activated sludge--full scale
Aeration
Batch growth
Bulking
-Continuous culture
Flocculant cultures, effects
Kinetics
Microbial activity & viability--indicators
Treatability studies

Activated sludge--operation & control
RT Activated sludge--full scale
Automatic control
Equalization
Management
Mechanical equipment

Activation
Def: opposite of inhibition
BT-Enzymes
-Metabolic control mechanisms
RT Induction
Inhibition
Repression

Adenosine triphosphate
U ATP

Adsorption--biochemical
Def: organic material on surface of flocc
BT-Unit operations
RT Adsorption--chemical
Flocculation--bacterial

Adsorption--chemical
BT-Unit operations
RT Activated carbon
Ammonia removal
Color
Desalination
Mass transfer

Aeration
BT-Unit operations
RT Activated sludge--full scale,--lab scale
Aerobic digestion
Aerobic lagoon
Mass transfer
Mixing
Oxygen requirement
Oxygen transfer
Oxygenation
Ozonation

Aerobic digestion
Def: reduces excess sludge prior to disposal
UF Sludge digestion
BT-Biochemical operations
RT Aeration
Extended aeration activated sludge
Sludge disposal

Aerobic lagoon
UF Completely mixed aerobic lagoon
BT-Biochemical operations
Lagoons
RT Aeration
Mixing

Air pollution sources
Def: wastewater treatment as source; bacterial, viral contamination
BT-Intermedia pollution transfer
RT-Biochemical operations
Incineration
Odor
Sludge disposal

Algae--nuisance organisms
RT Eutrophication
Lagoons
Lakes

Algae--nutrient removal by
RT Eutrophication
Nutrient requirements

Algae--physiological studies
RT Cell composition

Alkalinity
Def; major buffering system in biological systems
RT pH

Ames Salmonella test
U Mutagenesis

Amino acids (degradation of)
RT Carbohydrates
Cell composition
Lipids
Metabolic pathways
Mixed carbon sources
Nutrient requirements

Ammonia removal
RT Adsorption--chemical
Chlorination
Denitrification
Nitrification
Stripping

Anaerobic digestion
Def: reduces excess sludge prior to disposal
UF Sludge digestion
BT-Biochemical operations
RT Acidogenesis
Fatty acids
Methanogenesis
Sludge disposal

Anaerobic growth--lab scale
RT Acidogenesis
Anaerobic processes
Batch growth
Fatty acids
Hydrogen metabolism
Methanogenesis

Anaerobic processes
(incl. anaerobic filter, anaerobic contact)
BT-Biochemical operations
RT Acidogenesis
Denitrification
Fatty acids
Hydrogen metabolism
Methanogenesis

Analytical techniques
NT Biochemical oxygen demand
Biological analysis
Chemical analysis
Chemical oxygen demand
Mutagenesis
Oxygen measurement
Wastewater analysis
Water analysis
RT Instrumentation
Laboratory methods
Sampling

Aquatic ecosystems
U Ecology, aquatic

ATP
UF Adenosine triphosphate
High energy bonds
Oxidative phosphorylation
RT Bioenergetics
Microbial activity & viability-indicators

Automatic control
(of anything)
RT Activated sludge--operation & control
Computer
Instrumentation
Operation & maintenance

Bacteria
U generic names

Batch growth, death
(NOT activated sludge--lab scale)
(Used whenever applicable)
UF Cell culture
RT Activated sludge--lab scale
Anaerobic growth
-Continuous culture
Death
Kinetics
Semi-continuous culture
Treatability studies

Benthic deposits
Def: composition & effect on assimilative capacity of streams & lakes
RT Ecology, aquatic
Lakes
Oxygen tension
Streams

Bioassay
U Biological analysis

Biochemical operations
BT-Wastewater treatment systems
NT-Activated sludge
Aerobic digestion
Anaerobic digestion
Anaerobic processes
Denitrification
-Fixed film reactors
Immobilized enzymes
Nitrification

RT Combined treatment
-Industrial wastes
-Intermedia pollution transfer
-Unit operations

Biochemical Oxygen Demand (BOD)
(the test itself)
BT-Analytical techniques
RT Chemical Oxygen Demand
Oxygen measurement
Oxygen requirement

Biodisc
U Rotating Biological Contactor

Bioenergetics
UF Energetics of bacterial growth
Energy metabolism
RT ATP
Coupling of anabolism, catabolism
Maintenance energy
Nutrient requirements
Thermodynamics

Biological analysis
UF Bioassay
BT-Analytical techniques
RT Cell composition
Identification of species

Boundary processes
U Mass transfer

Bulking
Def: Activated sludge that won't settle
RT Activated sludge--full scale,--lab scale
Flocculant cultures, effects
Flocculation of bacteria
Settling, sedimentation

Carbon, source of
U Nutrient requirements

Carbohydrates (degradation of)
RT Amino acids
Cell composition
Lipids
Metabolic pathways
Mixed carbon sources
Nutrient requirements

Carcinogenesis
U Mutagenesis

Cell composition
(biochemical content)
RT Algae--physiological studies
Amino acids
Biological analysis
Carbohydrates
Lipids
Nucleic acids
Synchronous culture
Turnover of cell constituents

Cell culture
U -Continuous culture
Batch growth

Centrifugation
BT-Unit operations
RT Dewatering
Separation of microbes from fluids

Chemical analysis
BT-Analytical techniques
RT Instrumentation
Sampling

Chemical degradation
U Chemical oxidation

Chemical operations
(Use for general discussions; for specific operations use those listed under Unit operations)
BT-Wastewater treatment systems
RT Biochemical operations
Chemical oxidation processes
-Unit operations

Chemical oxidation process
UF Chemical degradation
RT Chemical operations
Chlorination
Color
Ozonation

Chemical Oxygen Demand (COD)
(the test itself
BT-Analytical techniques
RT Biochemical Oxygen Demand
Oxygen measurement
Oxygen requirement

Chemostats
U -Continuous culture

Chlorination
BT-Unit operations
RT Chemical oxidation
Mutagenesis
Odor

Chlorine compounds

Coagulation
BT-Unit operations
RT Color
Dewatering of sludges
Flocculation--chemical, bacterial
Flotation
Precipitation
Settling & sedimentation

Color
BT-Water quality
RT Adsorption--chemical
Chemical oxidation
Coagulation
Dyes

Combined treatment
(municipal & industrial wastes)
RT-Industrial wastes
Treatability studies
-Wastewater treatment systems

Commensalism
U Microbial interactions

Completely mixed aerobic lagoon (CMAL)
U Aerobic lagoon

Computers
(programming, programs, use)
(Used along with other terms to indicate specific applications: Design, Education, etc.)
RT Automatic control
-Mathematics

Contact stabilization activated sludge
UF Stabilization
BT-Activated sludge--full scale
RT Nitrification

Continuous culture--multistage(series)
(NOT activated sludge--lab scale)
UF Cell culture
RT Activated sludge--lab scale
Batch growth, death
-Continuous culture--steady state, etc.

Continuous culture--steady state
(NOT activated sludge--lab scale)
(Used whenever applicable.)
UF Cell culture
Chemostat
Continuous stirred tank reactor
Fermentation Turbidostats
RT Activated sludge--lab scale
Batch growth
Kinetics
Semi-continuous culture
Treatability studies

Continuous culture--transient state
(NOT activated sludge--lab scale)
UF Shock loads
Transient response
RT Dynamic response
Kinetics
Treatability studies

Continuous culture with recycle (pure)
UF Feedback (recycle) in continuous culture
RT Activated sludge--lab scale
Kinetics

Continuous dilution culture
Def: process for studying metabolic by-products
RT Metabolic pathways
Product formation

Continuous stirred tank reactor (CSTR)
U -Continuous culture

Control theory
Def: mathematics of system response--feedback, feed-forward.
RT Mathematical models
-Mathematics

Cooling ponds
BT-Unit operations
RT Heat transfer
Industrial water
Power plants

Cooling towers
BT-Unit operations
RT Heat transfer
Industrial water
Power plants

Costs
(real data)
RT Design
Economics
Operation & maintenance

Coupling of anabolism & catabolism
Def: regulation of carbon flow in organism.
RT Bioenergetics
-Enzymes
Kinetics
-Metabolic control mechanisms

Death of micro-organisms
RT Batch growth, death
Kinetics
Microbial activity & viability--indicators
Starvation survival of bacteria
Viability

Defoaming
U Foam destruction

Dehydrogenase
U Metabolic activity

Demineralization
BT-Unit operations
NT Desalination
RT Adsorption
Ion exchange
Reverse osmosis
Electrodialysis
Evaporation

Denitrification
Def: microbial activity converting nitrates to gaseous nitrogen
BT-Biochemical operations
-Unit operations
RT Ammonia removal
Anaerobic processes
Flow through porous media
Nitrification

Desalination
UF Saline water conversion
BT-Demineralization
-Unit operations
RT-Adsorption
Electrodialysis
Evaporation
Ion exchange
Reverse osmosis

Design
(sizing, costs--actual design decisions)
(Used with any individual or group of operations.)
RT Costs
Economics
Mathematical models
Operations research
Optimization
Reactor engineering
Scale-up

Dewatering of sludges (prior to disposal)
RT Centrifugation
Coagulation
Filtration

Discussion
(of a particular article)

DNA
U Nucleic acids

Dyes
RT Color
Industrial wastes
Tracer studies

Dynamic response
Def: time variant responses
UF Shock loads
Transient response
RT Continuous culture-transient state
Tracer studies

Ecology, aquatic
UF Aquatic ecosystems
RT Eutrophication
Lakes
Population dynamics
Streams

Ecology, microbial
(General articles)
NT Microbial interactions
RT Population dynamics

Economics
RT Costs
Design
Management
Operations research

Education
RT Environmental Engineering
Manpower
Publication

Effluent Character
Def: chemical nature of effluent of treatment system (not COD,BOD)
RT Chemical analysis
Extracellular polymers
Mutagenesis
Water reuse

Electric power
(requirements for wastewater treatment system)
RT Mechanical equipment

Electrodialysis
BT-Unit operations
RT Demineralization
Desalination

Endogenous metabolism
RT Kinetics
Metabolic activity
Starvation survival
Turnover of cell constituents
Viability

Energetics
U Bioenergetics

Energy metabolism, transfer
U Bioenergetics

Environmental Engineering
(Non-technical articles)
RT Education
Manpower
Publication

Enzymes & enzyme activity
NT Activation
Immobilized enzymes
Induction
Inhibition
Permease systems
Repression
RT Coupling of anabolism & catabolism
Kinetics
Metabolic activity
Metabolic control mechanisms
Nucleic acids

Equalization (of influent waste strength)
RT Activated sludge--operation & control

Eutrophication
RT Algae--nuisance,--nutrient removal by
Ecology, aquatic
Lakes
Oxygen tension
Streams

Evaporation
BT-Unit operations
RT Demineralization
Desalination
Lagoons
Lakes
Mass transfer

Extended aeration activated sludge (EAAS)
BT-Activated sludge
RT Aerobic digestion
Sludge disposal

Extracellular polymers
Def: by-products of bacteria; involved in floc formation
RT Effluent character
Flocculant cultures, effects
Flocculation--bacterial
Product formation
Settling & sedimentation

Fats
U Lipids

Fatty acids
Def: compounds with CH, COOH on end
UF Volatile acids
RT Acidogenesis
Anaerobic digestion
Anaerobic growth
Anaerobic processes

Feedback (recycle) in continuous culture (pure)
U Continuous culture with recycle

Fermentation
U-Continuous culture

Film flow reactors
U-Fixed film reactors

Filtration--cake
BT-Unit operations

Filtration--coarse media (granular filters)
UF Sand filtration
BT-Unit operations
RT-Fixed film reactors
Fluidization
Microscreen
Precipitation

Filtration--membrane & ultra
UF Membranes
BT-Unit operations
RT Microscreen
Reverse osmosis

Fixed film reactors
(any scale, full or lab)
UF Trickling filters
BT-Biochemical operations
NT Rotating biological contactors
RT Filtration
Flow through porous media
Fluidization

Flocculant cultures, effects
RT Activated sludge--full, --lab scale
Bulking
Extracellular polymers
Settling & sedimentation

Flocculation--by chemical addition (incl. deflocculation, despersion)
RT Coagulation
Flocculation--bacterial
Precipitation
Settling & sedimentation

Flocculation--bacterial
RT-Activated sludge--full scale,-lab scale
Adsorption--biochemical
Coagulation
Extracellular polymers
Flocculation--chemical
Settling & sedimentation

Flotation
BT-Unit operations
RT Coagulation
Foam fractionation
Settling & sedimentation

Flow systems
U Non-ideal fluid regimes

Flow through porous media
UF Packed towers
BT-Unit operations
RT Denitrification
Fluidization Leaching
Pressure drops

Fluidization
Def: moving liquids through beds of solids
UF Fluidized bed reactor
BT-Unit operations
RT-Activated sludge
Filtration
-Fixed film reactors
Flow through porous media

Fluidized bed reactor
U Fluidization

Foam destruction
UF Defoaming

Foam fractionation
Def: removing surface active material
BT-Unit operations
RT Flotation

Grit removal
BT-Unit operations
RT Settling & sedimentation

Heat transfer
RT Cooling ponds
Cooling towers
Powerplants
Temperature
-Unit operations

High energy bonds
U ATP

Humic material
RT Residual organic matter

Hydrocarbons as substrate
(used in protein production)
RT Insoluble (liquid) substrates
Nutrient requirements

Hydrogen metabolism
(in gaseous state)
RT Acidogenesis
Anaerobic growth,--processes
Methanogenesis

Identification of microbial species
UF Micro-organisms, identification of
RT Biological analysis
(names of genera)

Immobilized enzymes
BT-Biochemical operations
-Enzymes

Incineration
BT-Unit operations
RT Air pollution sources
Sludge disposal

Induction
BT-Enzymes
-Metabolic control mechanisms
RT Activation
Inhibition
Repression

Industrial wastes
(specific examples)
NT Dyes
Meat industry
Pesticides
Petrochemicals
RT Combined treatment
Treatability studies
-Wastewater treatment systems

Industrial water
RT Powerplants
-Unit operations

Inhibition
BT-Enzymes
-Metabolic control mechanisms
RT Activation
Induction
Phenol
Repression

Insoluble (liquid) substrates
Def: immiscible liquids, one dispersed in the other
RT Hydrocarbon as substrate
Solid substrates

Instrumentation
RT-Analytical techniques
Automatic control
Laboratory methods
Sampling

Intermedia pollution transfer
Def: air pollution ⟷ solid wastes
air pollution ⟷ wastewater treatment ⟷ solid wastes
NT-Air pollution sources
-Water pollution sources
RT-Wastewater treatment systems

Ion exchange
BT-Unit operations
RT Demineralization
Desalination

Kinetics
UF Rates (of change in biological systems)
RT-Activated sludge
Batch growth, death
-Continuous culture
Coupling of anabolism & catabolism
Death
Endogenous metabolism
-Enzymes
Mathematical models
Metabolic activity
-Metabolic control mechanisms
Respiration rate
Yield

Laboratory methods
(Used with any topic reporting "how to do it in the laboratory".)
RT-Analytical techniques
Instrumentation
Sampling

Lagoons
(all except aerobic lagoons)
UF Oxidation ponds
Ponds
RT Algae-nuisance
Eutrophication
Evaporation
Settling & sedimentation
Sludge disposal
Tertiary ponds

Lakes
UF Ponds
RT Algae--nuisance
Benthic deposits
Ecology, Aquatic
Eutrophication
Evaporation

Leaching
BT-Unit operations
RT Flow through porous media

Lipids (degradation of)
UF Fats
RT Amino acids
Carbohydrates
Cell composition
Metabolic pathways
Mixed carbon sources
Nutrient requirements

Maintenance energy
(to maintain life)
RT Bioenergetics
Endogenous metabolism

Management
UF Personnel
RT Activated sludge--operation & control
Economics
Manpower
Operation & maintenance
Operations research

Manpower
UF Personnel
RT Education
Environmental Engineering
Management

Mass transfer
UF Boundary processes
BT-Transport phenomena
RT Adsorption
Aeration
Evaporation
Mixing
Oxygen transfer
-Unit operations

Mathematical models
(Articles with major emphasis on development or testing of a model.)
UF Modeling, models
NT Structured models
RT Control theory
Design
Kinetics
-Mathematics
Phenol

Mathematics
NT Statistics
RT Computer
-Mathematical models
Operations research
Optimization

Meat industry
BT-Industrial wastes

Mechanical equipment
NT Pumps
RT Electric power
Operation & maintenance
-Wastewater treatment systems

Membranes
U Filtration, ultra & membrane
Reverse osmosis

Metabolic activity
Def: measure of cells' ability to function.
UF Dehydrogenase
Q_{O_2}, Q_{CO_2}
Whole-cell assay
RT Endogenous metabolism
Enzymes
Kinetics
Microbial activity & viability-indicators
Respiration rate

Metabolic control mechanisms
NT Activation
Induction
Inhibition
Repression
RT Coupling of anabolism & catabolism
-Enzymes
Kinetics
Metabolic pathways
Salts

Metabolic pathways
(specific)
RT Amino acids
Carbohydrates
Continuous dilution culture
Lipids
-Metabolic control mechanisms
Nutrient requirements

Metabolic quotient (Q_{O_2}, Q_{CO_2})
U Metabolic activity

Methanogenesis
RT Anaerobic digestion, growth, processes
Hydrogen metabolism

Microbial activity & viability-indicators
UF Sludge activity indicators
RT Activated sludge--full scale, lab scale
Death
Metabolic activity
Starvation survival of bacteria

Microbial interactions
(Incl. general discussions & specific examples of two or more pure cultures mixed together)
UF Commensalism
Mixed cultures, effects of
Predation
BT-Ecology, microbial
NT Protozoa-bacteria interactions
RT Population dynamics

Micro-organisms
U Generic names

Micro-organisms, identification of
U Identification of micro-organisms

Microscreen
(for filtering algae, etc.)
BT-Unit operations
RT Filtration

Mixed carbon sources
(controlled mixtures, in the laboratory)
RT Amino acids
Carbohydrate metabolism
Lipids
Nutrient requirements

Mixed cultures
U Microbial interactions

Mixing
(the physical act of mixing, use of mixers, not effects on reaction)
RT Aeration
Electric power
Mass transfer
-Mechanical equipment
Oxygenation

Modeling, models
U-Mathematical models

Mutagenesis
UF Ames Salmonella test
Carcinogensis
BT Analytical techniques
RT Chlorination
Effluent character
Product formation

Nematodes

Nitrification
Def: bacteria oxidize ammonia for energy, convert to nitrite, -ate ions)
UF Stabilization of wastes
BT-Biochemical operations
-Unit operations
RT Ammonia removal
Contact stabilization activated sludge
Denitrification
Nitrogen fixation

Nitrogen deficient wastes
U Nutrient deficient wastes

Nitrogen fixation
RT Denitrification
Nitrification

Nitrogen limited growth
U Nutrient limited growth

Non-ideal fluid regimes
UF Flow systems
RT Mixing
Reactor engineering
Tracer studies

Nucleic acids
UF DNA
RNA
RT Cell composition
-Enzymes

Nutrient deficient wastes
UF Nitrogen deficient wastes
Phosphorus deficient wastes
RT Nutrient requirements

Nutrient limited growth
UF Nitrogen limited growth
RT Nutrient requirements

Nutrient requirements
(studies on amounts of O_2, N, P, C, needed for microbial growth)
UF Stoichiometry
RT Algae--nutrient removal by
Amino acids
Bioenergetics
Carbohydrates
Hydrocarbons as substrate
Lipids
Metabolic pathways
Mixed carbon sources
Nutrient deficient wastes
Nutrient limited growth
Phosphates-phosphorus
Oxidation-reduction potential
Oxygen requirement
Yield

Odor, odor control
BT-Water quality
RT Activated carbon
Air pollution sources
Chemical treatment
Chlorination
Ozonation
Taste
Water analysis

Operation & maintenance
(For operation & control of activated sludge, see Activated sludge--operation & control.)
RT Automatic control
Costs
Management
-Mechanical equipment
-Wastewater treatment systems

Operations research
(including systems analysis)
RT Design
Economics
Management
-Mathematics
Optimization

Optimization
RT Computers
Design
-Mathematics
Operations research

Organic contaminants
(detection & removal of low levels)
RT-Analytical techniques
Residual organic matter
Reverse osmosis
Toxic materials

ORP
U Oxidation-reduction potential

Oxidation ponds
U Lagoons

Oxidation-reduction potential
UF ORP
RT Nutrient requirements
Thermodynamics

Oxidative phosphorylation
U ATP

Oxygen measurement
BT-Analytical techniques
RT Instrumentation
Oxygen tension
Oxygenation

Oxygen requirement
(that must be satisfied during treatment; not equivalent to BOD, COD.)
RT Aeration
Nutrient requirements
Respiration rate
$T_b OD$

Oxygen tension
Def: dissolved oxygen (DO) concentration.
RT Benthic deposits
Eutrophication
Oxygen measurement
Water quality

Oxygen transfer
(more theoretical than aeration; concerned with rates of transfer, etc.)
RT Aeration
Mass transfer
Oxygenation

Oxygenation
RT Aeration
Mixing
Oxygen measurement
Oxygen transfer
Ozonation

Ozonation
BT-Unit operations
RT Aeration
Chemical oxidation process
Odor
Oxygenation

Packed towers
U Flow through porous media

Permease systems
Def: specific enzymes for taking material into cell.
BT-Enzymes

Personnel
U Management
Manpower

Pesticides
BT-Industrial wastes
-Toxic materials

Petrochemicals
BT-Industrial wastes
RT Hydrocarbons as substrate

pH
RT Alkalinity

Phenol
Def: inhibitory compound used in modeling studies; an industrial waste.
RT Inhibition
-Mathematical models
-Toxic materials

Phosphates--phosphorus
NT Phosphorus, luxury uptake of
RT Nutrient requirements

Phosphorus deficient wastes
U Nutrient deficient wastes

Phosphorus, luxury uptake of
BT-Phosphates-phosphorus

Photodegradation
UF Ultra-violet degradation

Physical operations
(Use for general discussions; for specific operations use those listed under Unit operations)
BT-Wastewater treatment systems
RT-Unit operations

Piping
U Pumps & piping

Pollution control strategies
(large scale systems)
BT-Wastewater treatment systmms
RT Water pollution sources

Ponds
U Lagoons
Lakes

Population dynamics
(specific examples of observations of particular species as microbial interactions affect population)
RT Ecology, aquatic
Ecology, microbial
Microbial interactions

Powerplants
(water requirements of)
RT Cooling ponds
Cooling towers
Heat transfer
Industrial water

Precipitation
BT-Unit operations
RT Coagulation
Filtration
Flocculation--chemical
Settling, sedimentation

Predation
U Microbial interactions

Pressure drops
(water pressure)
RT Flow through porous media
Pumps & piping

Product formation
(formed by the microbes, released to medium)
RT Continuous dilution culture
Extracellular polymers
Metabolic pathways
Mutagenesis

Protozoa-bacteria interactions
BT-Microbial interactions

Public relations

Publication
(incl. communication, writing, style, etc.)
RT Education
Environmental engineering

Pumps & piping
BT-Mechanical equipment
RT Pressure drops

Pure oxygen activated sludge (POAS)
BT-Activated sludge--full scale

Q_{O_2}, Q_{CO_2} (Metabolic quotient)
U Metabolic activity

Radiation

Rates (of change in biological systems)
U Kinetics

Reactor engineering
(types & configurations of reactors & effects on reaction extent, etc.)
RT Design
Kinetics
-Mathematical models
Non-ideal fluid regimes
Scale-up

Refractory organics
U Residual organic matter

Repression
BT-Enzymes
-Metabolic control mechanisms
RT Activation
Induction
Inhibition

Residual organic matter
UF Refractory organics
RT Humic material
Organic contaminants

Respiration rate
RT Kinetics
Metabolic activity
Oxygen requirement

Reverse osmosis
UF Membrane
BT Unit operations
RT Demineralization
Desalination
Filtration--membrane, ultra
Organic contaminants

Review article
(Can include extensive literature review in research article)

RNA
U Nucleic acid

Rotating biological contactors
UF Biodisc
BT-Biochemical operations
-Fixed film reactors

Rotifers

Saline water conversion
U Desalination

Salts
(effects of high salt concentration on reactions)
RT-Metabolic control mechanisms

Sampling
RT-Analytical techniques
Instrumentation
Laboratory methods
Statistics

Sand filtration
U Filtration--coarse media

Scale-up , effects of
(from lab- to pilot- to full-; geometric, dynamic, kinematic similarity)
RT Design
Reactor engineering

Semi-continuous culture
RT-Continuous culture
Batch growth

Separation of microbes from fluids
(for recycle; how to do it in general, any scale)
RT Centrifugation

Settling & sedimentation
BT-Unit operations
RT-Activated sludge--full scale
Coagulation
Extracellular polymers
Flocculant cultures, effects
-Flocculation
Flotation
Grit removal
Lagoons
Precipitation
Thickening

Sewage treatment
U -Wastewater treatment systems

Shock loads
U Continuous culture--transient state
Dynamic response

Sludge activity indicators
U Microbial activity & viability--indicators

Sludge digestion
U Aerobic digestion
Anaerobic digestion

Sludge disposal
RT-Activated sludge--full scale
Aerobic digestion
Air pollution sources
Anaerobic digestion
Extended aeration activated sludge
Incineration
Lagoons

Sludge volume index (SVI)
(indication of settlability)
RT-Activated sludge
Settling & sedimentation

Solid substrates
RT Insoluble (liquid) substrates

Stabilization of wastes
U Contact stabilization activated sludge
Nitrification

Starvation survival of bacteria
RT Death
Endogenous metabolism
Microbial activity & viability--indicator
Viability

Statistics
BT-Mathematics
RT Sampling

Step aeration activated sludge
BT-Activated sludge--full scale

Stoichiometry
U Nutrient requirements

Streams
(any aspect)
RT Benthic deposits
Ecology, aquatic
Eutrophication

Stripping
Def: removing gas from liquid
BT-Unit operations
RT Ammonia removal

Structured models
Def: form of deterministic model dealing with internal configurations,(DNA, etc,) not just gross total.
BT-Mathematical models

Sulfur metabolism

Synchronous culture
Def: all cells divide at same time; used to study chemical composition of cells at different life cycle stages.
RT Cell composition

Taste
BT-Water quality
RT Odor

T_bOD
U Total Oxygen Demand

Temperature
RT Heat transfer

Tertiary ponds
RT Lagoons

Thermodynamics
Def: energy available in system for use by organisms
RT Bioenergetics
Oxidation-reduction potential

Thickening
Def: increasing solids by concentration
RT Settling & sedimentation

Total Oxygen Demand
RT Oxygen requirement

Toxic materials
NT Phenol
Pesticides
RT Organic contaminants

Trace quantities of organics
U Organic contaminants

Tracer studies
(in hydraulic systems)
RT Dyes
Dynamic response
Non-ideal fluid regimes

Transport phenomena (not used)
NT Heat transfer
Mass transfer
Momentum transfer (not used)
RT-Unit operations

Transient response
U Continuous culture--transient state
Dynamic response

Treatability studies
(prior to actual design)
RT Activated sludge--lab scale
Batch growth
Combined treatment
-Continuous culture
-Industrial wastes

Trickling filters
U Fixed film reactors

Turbidostats
U Continous culture

Turnover of cell constitutents
Def: internal utilization of compounds
RT Composition of cells
Endogenous metabolism

Ultra-violet degradation
U Photodegradation

Unit operations
BT-Wastewater treatment operations
NT Adsorption
Aeration
Centrifugation
Cooling ponds
Cooling towers
Demineralization
Denitrification
Desalination
Electrodialysis
Evaporation
Filtration
Flotation
Flow through porous media
Fluidization
Foam fractionation
Grit removal
Incineration
Ion exchange
Leaching
Microscreen
Nitrification
Oxygenation
Ozonation
Precipitation
Reverse osmosis
Settling & sedimentation
Stripping
Wet air oxidation

Unit operations, cont.
RT Chemical operations
Heat transfer Industrial water
Mass transfer
Physical operations

Viability
RT Death
Endogenous metabolism
Microbial activity & viability--indicators
Starvation survival of bacteria

Volatile acids
U Fatty acids

Wastewater analysis
BT-Analytical techniques
RT Organic contaminants
Sampling

Wastewater treatment systems
BT-Pollution control strategies
NT-Biochemical operations
Chemical operations
Physical operations
-Unit operations
RT Combined treatment
Electric power
-Industrial wastes
-Intermedia pollution transfer
-Mechanical equipment
Operation & maintenance

Water analysis
BT-Analytical techniques
RT Mutagenesis
Organic contaminants
Sampling
-Water quality

Water pollution sources
(General articles)
BT-Intermedia pollution sources
RT-Industrial wastes
-Pollution control strategies

Water quality
(Incl. EPA standards)
NT Color
Odor
Taste
RT Oxygen tension
Water analysis
Water reuse

Water reuse
RT Effluent character
Industrial water
-Water quality

Wet-air oxidation
BT-Unit operations

Whole cell assay
U Metabolic activity

Yield
Def: cells formed per substrate used; sludge formation
RT Kinetics
Nutrient requirements